

Introduction

We hope that the installation of your new Novak adapter assembly goes smoothly and that you achieve the improved results with your Jeep® that you intend. This kit is for adapting the Muncie SM420 manual transmission to the Jeep® New Process Model 231 transfer case, as found in 1988 to 2004 Jeeps.



Despite whatever your experience with this type of work may be, we strongly advise you to read these instructions well and save them for future reference and parts numbers. Contained in these instructions are the requirements, tips, hints and tricks of years of performing these conversions, both in our own facility and information we've gained from discussing this swap with our customers. Put this information to good use.

JEEP POWERTRAIN SUPERIORITY

About the SM420 Transmission

The SM420, as found in ½ to 2 ton GM trucks from 1947 to 1967, reigns supreme for its low gearing and ease of converting into a Jeep. Its strength, shorter length and ease of finding make it an attractive swapping option, especially when connecting it to an early GM truck, Chevy car or Buick bellhousings. Though some state that the 420 is not easy to find, and parts are sometimes difficult to locate, we come across these transmissions often, and have noted that the parts that are not available for the 420, because of its strength, are probably not needed in most cases. Bearings, seals, small parts and synchros remain largely available.

Identification

The cast iron transmission case is identified by the bulge out the passenger side and a PTO plate on the drivers side. Later versions had two horizontal ribs cast into the passenger side of the case. Early versions had a grooved section in the neck of the input shaft for sealing purposes. Later versions used a conventional in-retainer seal. Only in the last year of the 420 did it have a reverse backup switch in the top cover. Gears two through four are synchronized with first and reverse being non-synchronized.

Identifying the year of the transmission is tricky, but feasible. There are three eras of the SM420:

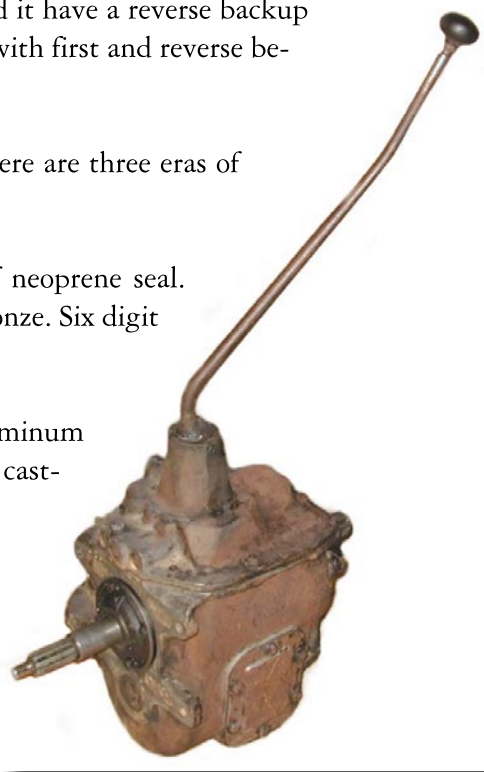
1947-1953: No ribs on the case, grooved input shaft instead of neoprene seal. Synchro rings all differ from each other. 1st-2nd synchro ring is bronze. Six digit casting number on the case, usually like "591xxx".

1954-1963: Same as previous but uses a neoprene input oil seal.

1964-1967: Same as previous except 1st-2nd synchro ring is aluminum and 3rd-4th synchro rings are identical to each other. Seven digit casting number usually like "38xxxxx" or "39xxxxx".

Compatibility

The SM420 enjoys wide compatibility with most GM engines. It's 4-11/16" front bearing retainer indexes to many GM standard shift bellhousings, including Buicks, GM cars and pre-'67 GM trucks. The latter are common donors of the SM420. It is important that you measure the locating bore on the bellhous-





ing to confirm the 4-11/16" diameter before performing the swap. Note that it is possible to machine an indexing ring so that transmission may fit the larger 5-1/8" bore. We or a good machine shop in your area can make such a locating ring. Note that both two and four-wheel-drive versions of the Muncie 420 are compatible with our kits.

While the Muncie 420 can be used with any GM engine having a 4-11/16" bellhousing bore and the "regular" GM transmission bolt pattern, this transmission installs more easily with the open bottom Chevrolet bell housings because the lower holes in the transmission case are threaded rather than drilled for clearance. The threaded hole case cannot be modified, so the lower attaching bolts must be installed from inside the bellhousing. This is minorly inconvenient on full circle (one piece) bell housings such as Buick V6 and 1962 and newer Chevrolet V8. The lower bellhousing holes must be drilled for bolt clearance (17/32" drill) and the clutch

release arm, bearing, and bellhousing must be assembled to the transmission and then assembled as a unit to the engine. While this may not be convenient, it is not difficult and the results are worthwhile.

Note that there are some versions of the SM420 have a protruding front shifter assembly that will necessitate machining a small pocket into the rear face of your bellhousing. These versions are rarer, but be aware that it is a possibility.



The common transmission pattern as found on most Chevy and many GM bell housings from 1947-1991.

The Conversion Procedure

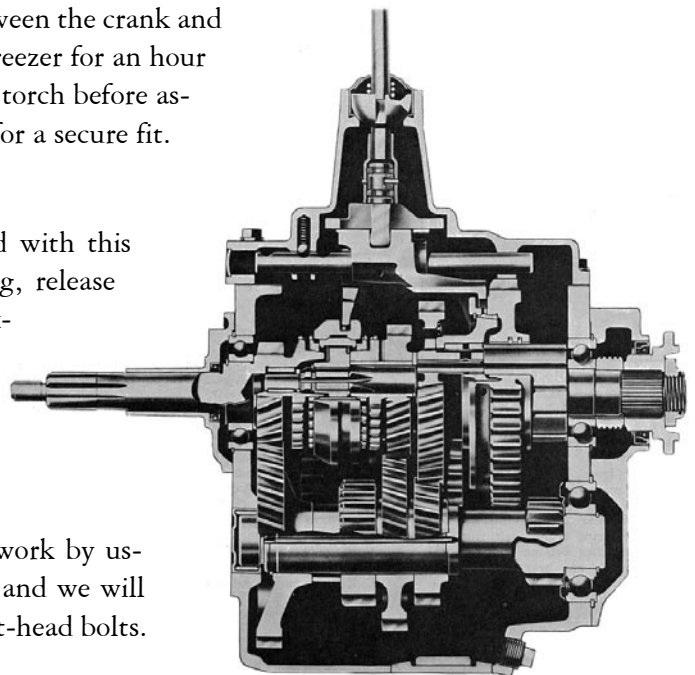
Installing the Pilot Bushing

Before installing the transmission to the engine, the special pilot bushing provided (if applicable) must be installed in the AMC or GM crankshaft. A piece of broomstick makes a good drift punch to install the pilot bushing. Never hammer directly on the bushing as it is quite soft, and it will surely be damaged by such a technique. If the tolerances are tight between the crank and bushing, you may wish to set the pilot bushing in the freezer for an hour and then very lightly warm the end of the crank with a torch before assembly. This facilitates some installations and provides for a secure fit.

Adapting the SM420 to an AMC Engine

1972-2004 AMC I6 and V8 engines can also be used with this transmission but must be equipped with a bellhousing, release arm, release bearing, and clutch disc from a 1980-86 six-cylinder CJ. The 420 Muncie uses two types of lower bolt holes. One offers clearance for a bolt and the other is drilled and tapped for the bolt to screw into. Either of these types will work with this procedure.

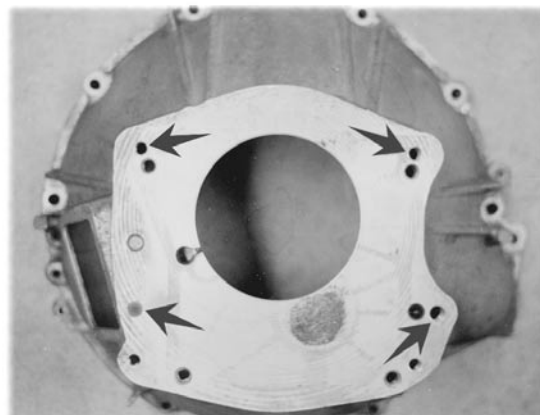
You can save some parts chasing and cost of machine work by using our #420-AMC kit. Send us your SM420 retainer and we will modify it and supply the special pilot bushing and socket-head bolts. Call us for details.



A cutaway of the SM420 transmission. A look at its components and design make it apparent why the transmission is so durable and rated to such high duty levels.

Install the modified retainer on the GM transmission using 5/16-18

x 7/8 socket head (Allen) bolts. We can provide the service of drilling and tapping of the bellhousing. Place the bellhousing on the floor, engine side down (you may have to put a couple of 2x4's or similar under it) and stand the transmission on its face on the bellhousing. In other words, just like it would be in use, only now it's standing vertically. Align the cover gasket surface of the transmission with the dowel pin holes in the bellhousing. Transfer the mounting bolt hole pattern of the transmission to the bellhousing. Drill the two upper holes with a letter "U" or 23/64" size drill and tap these two holes 7/16-14.



If the SM420 has lower holes that are not threaded, proceed as follows: Drill the lower drivers side hole of the 465 through with a 1/2" drill. Drill the lower passenger side hole with a 27/64" drill and tap this hole 1/2-13 thread. On the lower drivers side hole, install a 7/16" bolt with the head inside the bellhousing and a nut and lockwasher at the ear of the transmission. Use a 1/2-13 bolt in the passenger side lower hole. If the 420 has lower holes that are threaded proceed as follows: Drill the lower drivers side hole through the bellhousing with a 15/32" drill. This bolt will be 7/16-14 with the head inside the housing. Drill the lower passenger side bolt with a letter U or 23/64" size drill and tap this hole 7/16-14. A 7/16-14 bolt should just pass through the lower ears on threaded type 465 transmission. If not, a few strokes with a round file will provide clearance.

Note that there are some versions of the SM420 have a protruding front shifter assembly that will necessitate machining a small pocket into the rear face of your bellhousing. These versions are rarer, but be aware that it is a possibility.

While these written instructions may sound complicated, the actual procedure is really quite simple and the end result is most worthwhile.

About Your Novak Adapter

The Novak #421 adapter kit is built to high standards of design, materials and build. The adapter housing is cast of 356-T6 aluminum and is gasketed for remarkable strength. Our adapter shaft is machined of a triple-alloy gear steel, specially hardened and precision ground for strength and longevity.

Novak warranties your adapter and shaft against defects of workmanship and materials for the life of the vehicle. This warranty is non-transferable and requires a copy of your invoice as documentation. These components are not warranted against damage or defects resulting from improper installation, including misalignment, improper assembly, improper mounting, or incorrect driveshaft lengths, and miscalculated driveshaft geometry on shackle reversal setups. Because we have no control over how the parts are handled or installed, we are not liable for any problems or failures of this product unless it is a defect of design, materials or workmanship. Determination of this warranty is at the fair discretion of Novak, Inc.

Should you have any questions concerning this conversion or these components, we welcome you to contact us.

We've also developed a pretty slick method of placing a CPS (Crank Position) sensor into a '76-'86 AMC 258 bellhousing to make it compatible with the 4.0 engines. Call us for details on this.

Bellhousing Alignment

On any engine using a standard shift transmission, with or without an adapter, it is important to check the bellhousing locating bore location relative to the crankshaft. The potential for transmission failure or premature wear is so great, due to misalignment at this point, that no engine should be assembled without being checked. The checking procedure is quite simple. Correcting misalignment is not so simple but must be done to insure normal service from the transmission. A dial indicator is required, as well as a suitable means to mount this instrument on the engine crankshaft.

A dial indicator (right) is a device that has an arm or contact point, suitably connected to a pointer, that moves in front of a dial with markings on its face. These markings usually represent .001" each. The purpose of a dial indicator is to measure in thousandths of an inch that can be read directly on the dial of the indicator.

To check a bellhousing, mount it on the engine it's going to be used with, make sure there are no burrs or dirt on the block or bellhousing. All bellhousing

ing to block bolts should be in and tight. Mount the dial indicator on the crankshaft of the engine using a suitable magnetic base attachment or mechanical clamping means. The contact point of the indicator should be touching the bore of the bellhousing. The indicator must be mounted rigidly enough so it does not move on its mounting to prevent false readings. Rotate the engine by hand with the spark plugs removed and observe the reading on the dial. Keep adjusting the dial assembly until the needle moves the least amount per rotation. When you have achieved the least amount of needle movement through the 360 degree sweep of the indicator, this is your runout. You can then determine the direction it is offset by the movement of the needle.



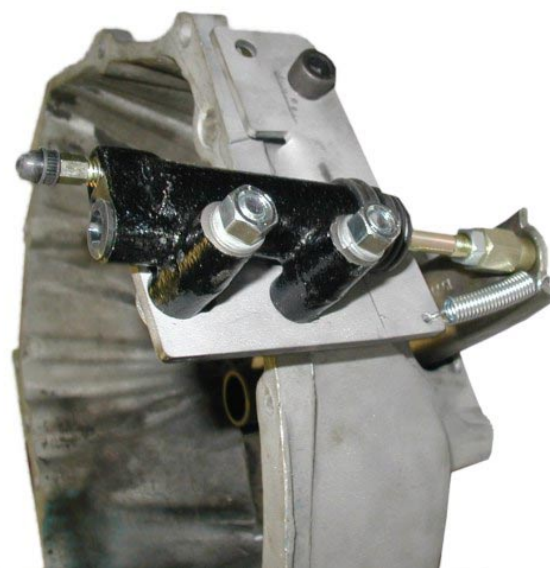
The total number of thousandths misalignment of the bore relative to the crankshaft is read directly on the dial. Total runout should not exceed .007", with .010" being maximum. The greater the misalignment, the sooner transmission problems and failure will occur. A symptom of misalignment is unusual wear of the pilot bushing. We have checked stock Chevy bellhousings on engines that were out more than 1/32" (.032"). Some Ford ones are reportedly worse. Anything over .010" runout must be corrected before the engine and bellhousing are put in service or you can count on pilot bushing, transmission, and clutch problems, followed by transmission failure. The simplest way to correct misalignment is to try another bellhousing or bellhousings. Machining the bellhousing is the best cure but offset dowel pins are simpler. Shims between the block and bellhousing will also work if you have the patience to use this method. Offset dowel pins are sometimes available from speed shops locally or online.

Clutch System

The clutch is not so much dependant on the transmission being used as is the engine, but a general guideline is to use the flywheel and pressure plate as prescribed for your year and model of engine. The clutch disc must have a 1-1/8" x 10 spline hub to match the SM420 input shaft. Jeep specified a diameter and count of this size for most 1980 and later Jeeps with the T4, T5, SR4, T176, BA 10/5, AX15 and NV3550 transmissions.

You should retain your hydraulic master cylinder and then use a slave setup like the original Jeep version (with the exception of the integrated internal hydraulic release bearings) that use an external slave and pivoting release arm. A more in-depth discussion can be had at the Novak Knowledge Base, www.novak-adapt.com, or with a tech at Novak who may also be able to configure a clutch system that is most appropriate for your combination.

If you are running a GM bellhousing, we suggest our #HCR2 hydraulic clutch slave retrofit kit. This in concert with the master cylinder setup in most YJ, TJ and XJ Jeeps will make for a clean and easy to configure clutch release system.



Novak's #HCR2 hydraulic clutch release kit for GM aluminum bellhousings. See the Novak web site for more details or call us.

Transmission to Transfer Case Conversion Procedure

You may wish to do a full rebuild of your transmission while you are replacing the mainshaft, as this constitutes a major portion of an otherwise master rebuild. As such, we are including our full rebuild instructions below. If you choose to simply replace your mainshaft, concentrate on the passages that apply.

Remember throughout your installation/rebuild, that you are dealing with hardened metals in this transmission. Hammering, pressing or shocking any surface with any tool that is not significantly softer than the steel being serviced will chip or break parts. Always use brass, aluminum or wood drifts to drive parts. Do not use screwdrivers alone to pry off snap rings.

The three tools that transmission disassembly requires that may not be in your tool chest already are:

- 1) Heavy duty external snap ring pliers
- 2) Bearing puller/splitter set
- 3) Hydraulic shop press and various arbors/sleeves

These tools can be rented, borrowed or even purchased for prices that should not be too shocking.

Transmission Assembly and How it Works

The mainshaft and first and reverse sliding gear incorporates a method of spline attachment known as the skip-tooth design. Synchronization is obtained in all forward speeds except first. The second speed synchronizer cone is located in the first and reverse gear as illustrated below. Parts making up the shifting unit, with exception of the clutch hub, are shown below. Also see the exploded view of transmission assembly. The SM420 countershaft features removable gears (except first).



Above: Tools common to a gearbox rebuild. Bearing and gear pullers will vary. Below: A set of large, bevel tipped, external snap ring pliers is indispensable for removing the large Eaton type retaining rings you'll encounter. These shown are under the Blue Point brand.

Disassembling the Transmission

1. After removal of the top cover bolts, remove transmission cover assembly by lifting it straight up from the transmission.
2. Remove lock spring from nut on reverse shifter lever eccentric and remove the nut. Drive the eccentric out of the case and remove the lever.
3. Place the transmission in two gears at once to lock gears and remove universal joint flange retaining bolt, lockwasher, and special washer.
4. Pull the universal joint flange, or flange and brake drum assembly from the mainshaft. Remove speedometer gear, if so equipped. Note that the speedo drive gear is installed on the main shaft in some models and on the universal joint flange on other models.
5. Remove rear bearing retainer and its gasket.
6. To remove the mainshaft assembly the entire assembly must be pulled back to remove the rear mainshaft bearing from the case. Install a puller to rear face of transmission case and pull the bearing. We've noticed that some of these slide out without a puller.
7. Move the mainshaft assembly back as far as it will go.
8. To remove mainshaft rear bearing install a bearing puller as shown and remove bearing from shaft.
9. Remove input shaft bearing retainer, then remove clutch gear and bearing by tapping from inside of case. Caution: Index cut out section of clutch gear with countershaft driven gear to obtain clearance in removing clutch gear and shaft.
10. Remove mainshaft, gears and synchronizers from the case as an assembly.
11. Remove the input shaft synchronizer ring and transmission mainshaft pilot bearing roller spacer from end of mainshaft.
12. Remove speedometer driven gear from rear bearing retainer, if present.



This style of snap ring plier is more universal, with a dimpled and knurled flats. They are great for smaller snap rings.



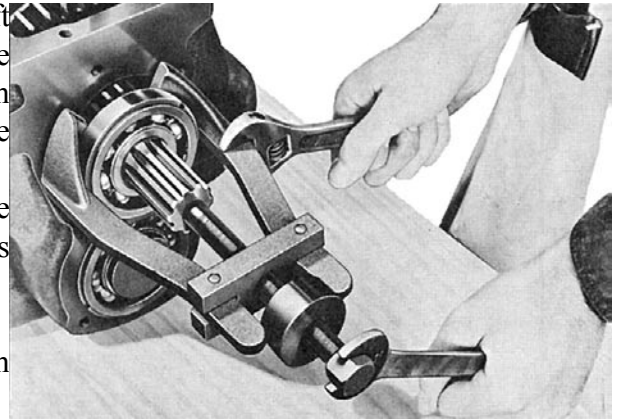
13. To remove reverse idler gear, drive out reverse gear shaft retaining pin using a small punch. This pin is driven into the shaft after which the shaft may be driven out of the case from front to rear using a brass drift. With shaft removed, remove reverse idler gear from case.

14. Drive countershaft with rear bearing to the rear of case using a brass drift on front end of shaft until rear bearing is driven out of the case.

15. Remove rear bearing snap ring.

16. Using a puller, remove rear bearing and oil deflector from rear end of countershaft.

17. Raise front end of countershaft assembly and lift from case.



The "skip-tooth" first/reverse gear splines and spline shaft design. Note that we have encountered very rare versions of the 420 that used all 22 splines on the shaft and gear. We recommend replacing this gear with a good used 11 spline version.

Input Shaft Disassembly

1. Remove transmission mainshaft pilot bearing rollers (all 18 of them) from clutch gear if not already removed and remove transmission mainshaft pilot bearing roller retainer from recess in shaft.

2. Remove snap ring securing bearing on stem of clutch gear.

3. To remove bearing, place clutch gear and bearing assembly in an arbor press and using a press and fixtures as shown. This can also be done with a bearing puller.

Inspection

1. Wash all parts in cleaning solvent.

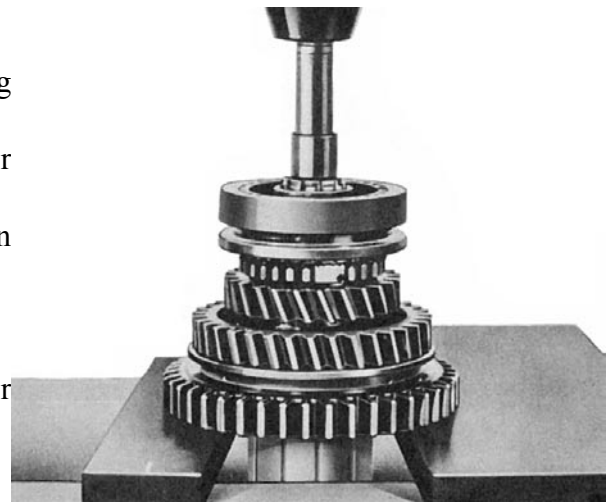
2. Inspect roller bearings for pits or galling.

3. Inspect bearing diameter in shaft recess for galling.

4. Inspect gear teeth for excessive wear.

5. Inspect clutch shaft pilot for excessive wear.

6. Rotate clutch gear bearing slowly by hand and check for roughness.



Assembly

1. Install bearing on shaft and using a press to push bearing into position.

2. Install snap ring to secure bearing on clutch gear stem.

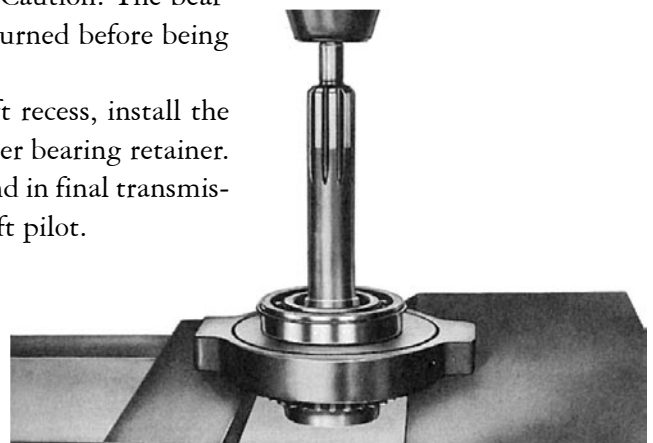
3. Install bearing retainer ring in groove in O.D. of bearing. Caution: The bearing must turn as freely, after it is installed to the shaft, as it turned before being placed on the shaft.

4. Apply a small amount of grease to bearing surface in shaft recess, install the 18 transmission mainshaft pilot roller bearings and install roller bearing retainer. Note: This roller bearing retainer holds bearings in position and in final transmission assembly it is pushed forward into recess by the mainshaft pilot.

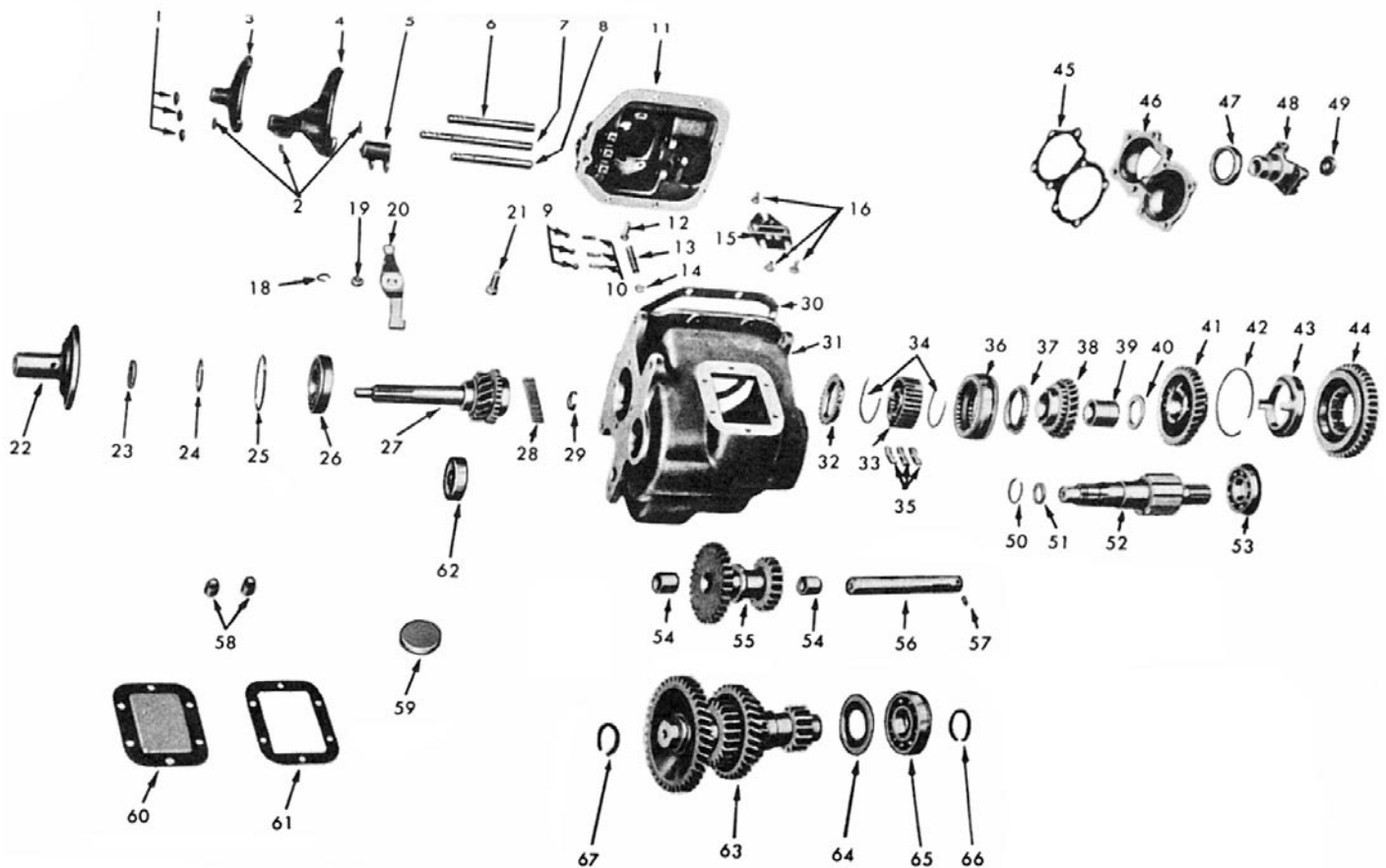
Clutch Gear Bearing Retainer Oil Seal Removal and Installation

1. Remove retainer and oil seal assembly and gasket.

2. Pry oil seal out of retainer.



SM420 Exploded View



Legend

- | | |
|--|--|
| 1. Expansion Plug | 36. Third and Fourth Speed Clutch Sleeve |
| 2. Roll Pin | 37. Third Speed Gear Synchronizer Cone |
| 3. Third and Fourth Speed Shifter Yoke | 38. Third Speed Gear |
| 4. First and Second Speed Shifter Yoke | 39. Third Speed Gear Mainshaft Bushing |
| 5. Reverse Shifter Head | 40. Second Speed Gear Thrust Washer |
| 6. Third and Fourth Speed Shifter Shaft | 41. Second Speed Constant Mesh Gear |
| 7. First and Second Speed Shifter Shaft | 42. Second Speed Gear Synchronizing Ring Retainer |
| 8. Reverse Shifter Shaft | 43. Second Speed Gear Synchronizing Ring |
| 9. Yoke Detent Ball | 44. First and Reverse Gear Assembly |
| 10. Yoke Detent Ball Spring | 45. Transmission Rear Bearing Retainer Gasket |
| 11. Transmission Cover | 46. Transmission Rear Bearing Retainer |
| 12. Reverse Shifter Compression Pin | 47. Oil Seal |
| 13. Reverse Shifter Compression Pin Spring | 48. Universal Joint Front Flange |
| 14. Expansion Plug | 49. Special Washer |
| 15. Shifter Interlock Plate | 50. Third and Fourth Speed Clutch Hub Retainer Ring |
| 16. Shifter Interlock Pin | 51. Transmission Mainshaft Pilot Roller Bearing Spacer |
| 18. Lock Spring | 52. Transmission Mainshaft |
| 19. Slotted Hexagon Nut | 53. Transmission Mainshaft Bearing |
| 20. Reverse Shifter Lever | 54. Reverse Idler Bushing |
| 21. Reverse Shifter Lever Eccentric | 55. Reverse Idler Gear |
| 22. Clutch Gear Bearing Retainer | 56. Reverse Idler Gear Shaft |
| 23. Clutch Gear Bearing Retainer Lip Seal | 57. Roll Pin |
| 24. Clutch Gear Stem Snap Ring | 58. Drain and Filler Plugs |
| 25. Clutch Gear Bearing Retainer Ring | 59. Magnetic Chip Collector (Bonded to Case) |
| 26. Clutch Gear Bearing | 60. Power Take Off Cover |
| 27. Clutch Gear | 61. Power Take Off Cover Gasket |
| 28. Transmission Mainshaft Pilot Roller Bearings | 62. Countershaft Front Bearing (#2412 for 3/4-ton version, #2412 or #1206 for 1-ton version) |
| 29. Transmission Mainshaft Pilot Roller Bearing Retainer | 63. Countershaft Assembly |
| 30. Transmission Cover Gasket | 64. Countershaft Rear Bearing Oil Deflector |
| 31. Transmission Case | 65. Countershaft Rear Bearing |
| 32. Input Shaft (Clutch Gear) Synchronizer Cone | 66. Countershaft Bearing Snap Ring |
| 33. Third and Fourth Speed Clutch Hub | 67. Snap Ring |
| 34. Third and Fourth Speed Clutch Key Spring | |
| 35. Third and Fourth Speed Clutch Keys (also called pawls, dogs or blockers) | |

3. Install new oil seal with a large diameter socket. The spring side of the seal faces toward the transmission.
4. Install new gasket on retainer. We recommend the use of RTV Gray. Install retainer on the transmission case.

Disassembling Mainshaft Assembly

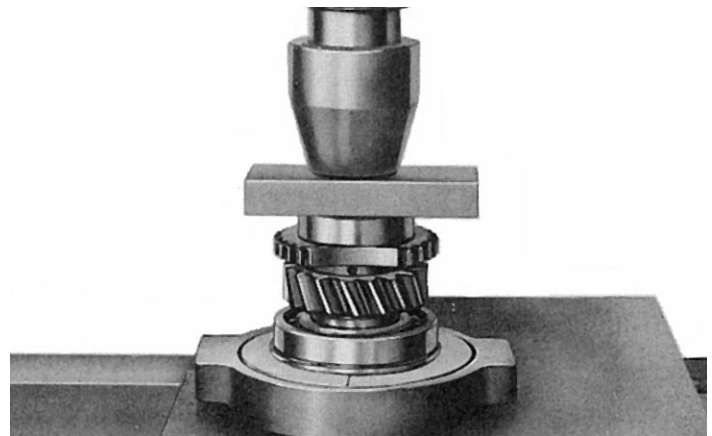
1. Remove the third and fourth speed clutch hub retainer ring from the pilot end of the mainshaft.
2. Support the assembly on first and reverse sliding gear in an arbor press (image) and press the mainshaft out of the gears..
3. Remove third and fourth speed clutch key springs from third and fourth speed clutch hub and remove clutch sleeve from clutch hub.
4. Remove third speed gear synchronizer cone from third speed gear.
5. Remove third speed gear mainshaft bushing from third speed gear.
6. Remove third speed gear. Note: Second speed thrust washer goes between third gear and second gear.
7. Remove second speed gear from second speed synchronizing ring lugs (also called keys, pawls, dogs, etc.
8. Remove second speed gear synchronizing ring retainer and remove second speed rear synchronizing ring from first speed gear.



Installing the 18 rollers into the input shaft bore.

Inspection

1. Wash all parts in cleaning solvent.
2. Inspect mainshaft for scoring or excessive wear at thrust surfaces or splines.
3. Inspect clutch hub and clutch sleeve for excessive wear and make sure sleeve slides freely on clutch hub. Also check fit of clutch hub on mainshaft splines. Note: Third and fourth speed synchronizer sleeve should slide freely on third and fourth speed synchronizer hub but clutch hub should be snug fit on shaft splines.
4. Inspect third speed gear thrust surfaces for excessive scoring and inspect third speed gear mainshaft bushing for excessive wear. Note: third speed gear must be a running fit on mainshaft bushing and mainshaft bushing should be press fit on shaft.
5. Check second speed thrust washer for excessive scoring.
6. Inspect second speed gear for excessive wear at thrust surface or in bronze bushing. Check synchronizer springs for looseness or breakage. Synchronizer springs may be replaced by removing the rivets and installing a new spring with new special rivets. Note: If bushing is worn excessively the gear assembly must be replaced.
8. Inspect second speed gear synchronizing ring for excessive wear. Inspect bronze synchronizer cone in 1st speed gear for excessive wear or damage. Also inspect clutch gear synchronizer cone and third speed gear synchronizer cone for excessive wear or damage. Note: First and reverse sliding gear must be sliding fit on mainshaft splines and must not have excessive radial or circumferential play. If sliding gear is not free on shaft, inspect for burrs which may have rolled up on front ends of half-tooth internal splines and remove by honing as necessary.
9. Inspect all gear teeth for excessive wear.
10. Inspect first and reverse gear friction rings and neoprene compression strips on



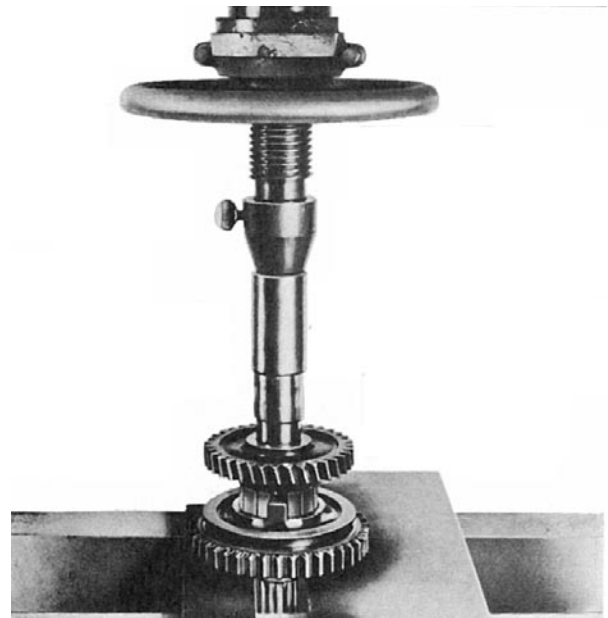
Installing the input bearing onto the input shaft, also called a "clutch gear" or "main drive gear".

Note: While small parts and bearings can often be reused, we recommend replacement of them. Your transmission will run quieter, longer and more durably with new bearings. This is especially important if you are replacing your mainshaft with a Novak conversion shaft. Our premium case-hardened gear steel and precision ground surfaces deserve new, quality bearings. Your 420 will run smoother than ever.

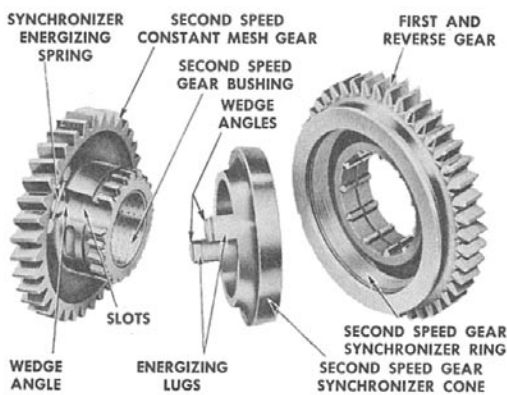
inside diameter of first and reverse gear for excessive wear or damage. Replace if necessary.

Transmission Assembly

1. Install second speed gear synchronizing ring into 1st and reverse sliding gear and install the second speed gear synchronizing ring retainer. Caution: Make sure synchronizing ring retainer is seated fully in snap ring groove of first gear.
2. Slide the first and reverse sliding gear on the mainshaft splines with synchronizing ring toward front of shaft. If difficulty is experienced in assembly of gear to mainshaft, seat the compression strips deeper in the gear grooves with a screwdriver or other suitable tool.
3. Install second speed gear on shaft with synchronizer springs toward synchronizing ring in first speed gear. Note: Position gear so that the two cut-out sections index with prongs on synchronizing ring in 1st speed gear.
4. Install second speed thrust washer. Install third speed gear mainshaft bushing on mainshaft using a press. A little heat with a torch on the bushing is sometimes helpful. It should bottom on second speed thrust washer.
5. Check end play of second speed gear. This end play should be .012" - .003".
6. Install third speed gear over mainshaft bushing and install third



Installing the third gear mainshaft journal bushing (sometimes called a plane bearing) onto the shaft. Caution: When installing, grease this bushing. This will assure proper initial lubrication. Press the bushing, but do not tap it, to avoid cracking. It is made of sintered iron, and while they are durable, they do not stand up to shock well.



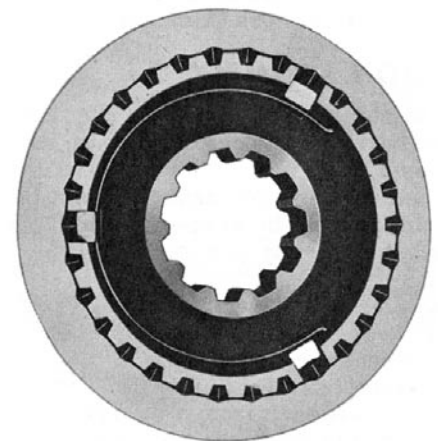
speed synchronizer cone on taper of third speed gear.

7. Install clutch sleeve over clutch hub so wider land on sleeve faces in same direction as long shoulder on hub. Drop the three clutch keys into position. Install clutch key springs, one on each side of clutch hub making sure springs fit under the clutch keys to hold them out against clutch sleeve. Note: Both clutch key springs must be installed in the same relative position to provide even tension on the three clutch keys.

8. Support mainshaft assembly in arbor press, install clutch hub assembly with wider land on clutch sleeve and long shoulder of clutch hub toward pilot on

mainshaft and press synchro hub assembly onto shaft until it bottoms out. Caution: Exercise extreme care that slots in third speed gear synchronizer cone index with the three clutch keys in synchro hub assembly.

9. Check end play of third speed gear. This end play should be .012" - .002".
10. Install synchro hub retainer ring.

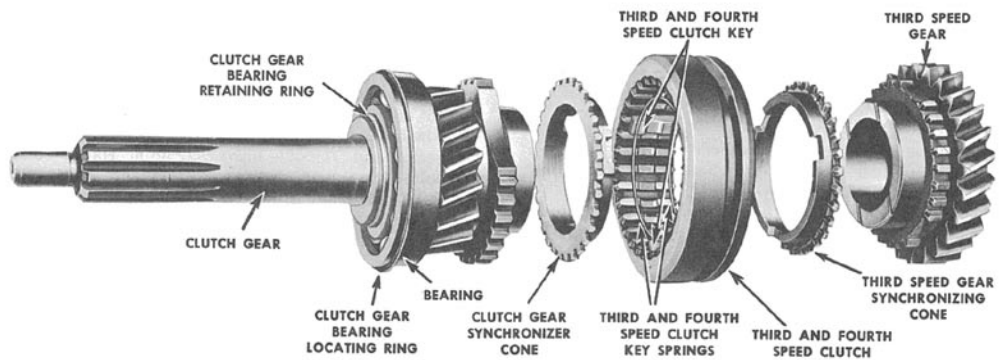


Note: The 3rd - 4th synchro hub retainer ring is a selective snap ring and should be checked carefully for proper thickness at assembly. There are three thicknesses of rings (.083", .087", .094") available. Therefore, be sure to select the proper ring that will assemble with .007" maximum end clearance.

Countershaft

Should it be necessary to replace any of the countershaft gears, the lock ring on front end of shaft should first be removed and then the assembly supported in an arbor press and the shaft pressed out of the train of gears. When reassembling the new gears to the countershaft, care must be taken to place gears in correct position on shaft. For example, the radius end of the second speed gear faces the first speed gear. The third speed gear is installed next

and inasmuch as both sides of this gear are identical it may be installed either way. The reverse speed gear is installed on the shaft next and must be installed so that the chamfered end of the teeth will face the counter driven gear. Only one spacer is used and that is installed between the reverse gear and the counter driven gear. The counter driven gear is installed last.



When pressing the gears on the countershaft, new countershaft drive pins should be used and after all gears are pressed into position, the round pins should be driven flush to 1/32" max. below flush with shoulder on counter driven gear hub. The snap ring installed as gear retainer, on front end of countershaft, is a selective lock ring and should be checked carefully for proper thickness at assembly.

Reverse Idler Gear Bushings

If the reverse idler gear bushings show signs of wear, they should be removed with a press and proper diameter shaft. This same tool may be used to replace these bushings in the gear. Press bushings into gear from each end until flush with ends of gear and then stake in position using a punch. Caution: It is important that these bushings be properly staked as they are split bushings and may have a tendency to creep if not properly staked. After the new bushings are installed and staked in position they must be line reamed to size.

Countershaft Front Bearing

The countershaft front needle bearing is a press fit into the transmission case. If, upon inspection it is found that this bearing needs replacement, it may be driven through and into the case using any suitable tool. To install bearing in case, use a suitable flat tool covering the entire front surface of the bearing. When installing, drive bearing in until it is flush with outside face of case. Your Novak rebuild kit has two bearings. The 3/4-ton version is a #2412 and the 1-ton version is a #2414 or #1206 bearing. Use whichever applies to your transmission and shelve the other for any future use.

Transmission Assembly

1. Install countershaft assembly in the transmission with rear bearing hub extending through rear bearing hole in case.
2. Install rear bearing oil deflector with projections located in gear tooth space and rear bearing on countershaft assembly and install bearing snap ring.
3. Move countershaft assembly forward and position in case. Note that the rear bearing outer snap ring limits forward movement of countershaft.
4. Place reverse idler gear in transmission case and install idler gear shaft from rear to front being careful to have slot in end of shaft in a horizontal position.
5. Drive idler gear shaft in until hole in shaft aligns with lock pin hole in case and install the lock pin.
6. Install mainshaft assembly into case with rear of shaft protruding out of rear bearing hole in case.
7. Install mainshaft rear bearing onto shaft using a



press. You may install the entire transmission into a press with the bearing inner race captured by steel plates.

8. Install transmission mainshaft pilot bearing roller spacer to pilot end of mainshaft, install clutch gear synchronizer cone to pilot end of mainshaft and move mainshaft forward until clutch sleeve clears third speed gear on countershaft assembly.

Index cut out portion of clutch gear teeth to obtain clearance over countershaft driven gear and install clutch gear assembly into case.

9. Install the input gear bearing retainer using a new gasket and RTV Gray. Apply a thread sealing compound to bearing or retainer bolt threads and install bolts and tighten to 15 ft. lbs.

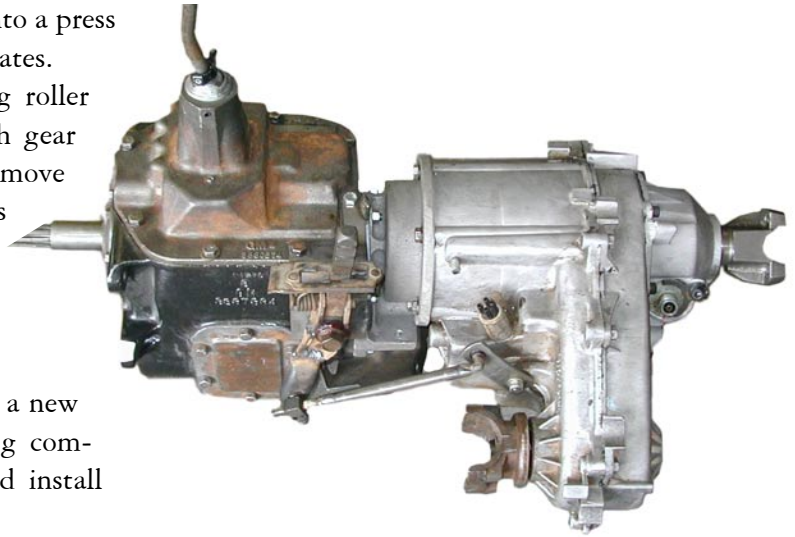
10. Raise front end of mainshaft and enter pilot into transmission mainshaft pilot bearing rollers in clutch gear.

11. Press mainshaft and bearing assembly into case. Install the rear bearing snap ring onto the shaft journal, applicable to Novak conversion shafts.

12. Install rear adapter or factory bearing retainer using a new gasket and RTV Gray. Apply thread sealant to rear bearing retainer bolt threads, install bolts and tighten to 35 to 45 ft. lbs. (described below)

13. Place reverse shifter lever into position and install shifter lever eccentric from inside case. Install slotted hex nut on eccentric and tighten nut finger tight.

14. Make sure all transmission gears are in neutral and using a new gasket, install cover assembly making sure shifting yokes slide over their proper gears and that reverse shifter lever properly engages reverse shifter head. Install transmission adapter or cover attaching bolts as below.



Adapter Installation

The adapter will replace the original 2wd or 4wd extension housing with the following notations: First, lube the adapter seal and transfer case input shaft before installing adapter. This adapter is machined to a median of factory specifications and is designed to be used with a 1/64 to 1/32" thick gasket between the transmission and adapter, as supplied. Note that gasket thicknesses from varying manufacturers vary, as will your endplay when using them.



The five studs supplied in the kit must be screwed into the five top holes in the back of the SM420 case. The flat end of these studs have oversize threads and go into the transmission case. The domed end of the studs have standard fit threads. Put the nuts on the domed ends. These studs can be screwed into the casting without damaging them by "locking" two nuts together on a stud and wrenching on the nuts rather than using Vise Grip pliers or similar tools that damage and weaken the stud.

With the adapter in place, tighten the nuts while working the adapter up to the face of the transmission. It is a wise idea to cross tighten the bolts and in three successive steps until all are tight. Do not use the bolts to press the adapter into place! If it does not slide easily into place, find and diagnose the source of the bind before tightening the bolts. Torque the bolts to 35/45 ft. lbs (oiled/dry).

Check Your Work and Seal it Up

Check the shafts for endplay with a magnetic dial gauge. You should have .003"-.009" and the shafts should turn freely in neutral and all gears. If end play needs to be adjusted, your small parts kit contains snap rings of varying

thicknesses which you may use to adjust this number. It is tedious to pull the bearings off and try again, but it is far more tedious to have the transmission break down prematurely.

Once satisfied with your transmissions operation, remove the adapter and the front input retainer. Use RTV silicone (we like Permatex® Gray) in thin layers on each side of each of the transmission gaskets. Install the bolts and torque them lightly until the silicone begins to squeeze out. Return and tighten the bolts to final spec (in an incremental crossing pattern) in a few hours after the sealant has solidified.

Transmission Lubrication

Fill the transmission with the right gear, usually 85W-140 for most climates. Use a GL-4 rated oil, not GL-5, as the latter has an increased amount of sulphur, which is lower in PH and acidic towards the bronze synchronizer rings in your transmission. StaLube and Redline make gear oils that match the GL-4 rating. We like to fill through the top cover, as it’s a good opportunity to douse the gears and shafts, not to mention the speed to fill.

Put the top cover on, making sure to line up the shifters with their sliders. Test shift through the gears. Some installers like to spin the input shaft pilot tip with a drill (read, Large Chuck) and listen for any noises. Once satisfied with the operation, RTV the shifter gasket like any other. Torqe the shifter bolts to 25 ft. lbs. in a crossing pattern.

Transfer Case Installation

231 Input Gears and Compatibility

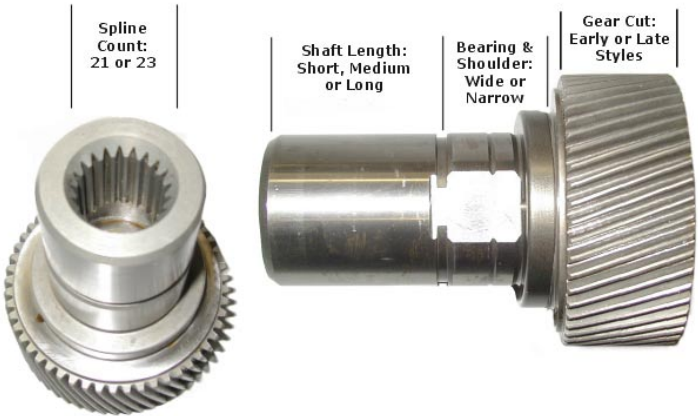
The important variations to look for in this transfer case when planning a conversion lie in the input gear. It comes in 21 spline and 23 spline versions with long, medium (rare) and short variations.

	21 Spline	23 Spline
Short Input	AW4 (through 1990) AX4 AX5	Earlier (pre-'95) AX15 AW4 (post-'90)
Long Input	Peugeot BA 10/5	Peugeot BA 10/5 Later (post-'94) AX15 TF904 TF999
Medium Input		Jeep ZJ's '93 to '95 only

The long shafts protrude 2.1” from the front mounting face of the transfer case. The short version protrudes 1.2”. The rare medium shafts protrude 1.7”. You should be careful when swapping any of these gears due to different bearing widths and gear teeth. The following chart shows how to determine which input gear you should have by transmission. It is always good to verify first hand if possible.

Because of differences in the cut of the gear, as a general rule; one should not interchange pre-'95 gears with post-'94 gears. These years are not hard and fast delineations. If one is not absolutely certain, disassembly and inspection is required.

Note that some transmissions change spline count. The AW4 had 21 splines through 1990. In 1991, the same year the 4.0 HO was introduced, the AW4 splines increased to 23.



We work closely with our customers, and our website assists them in making an informed decision about which adapter kit to buy in terms of spline count and input gear length. It is possible that not every variation that Jeep has will not match the documentation available. Check these features early in the process, noting that your adaptation will require a seal spacer sleeve if you have the short version of the input gear. This ensures that the actual adapter seal reaches the transfer case seal journal. If installing our spacer sleeve, lay a light fillet of RTV into the machined shoulder of the spacer where it meets the adapter seal bore. Gently press or drive this part into place.

Wire brush your transfer case input gear splines if necessary. Grease your transmission shaft output splines and transfer case input splines with a heavy black or synthetic grease. This adds to the life and long-term longevity of the hardened spline faces that transfer so much power through your drivetrain. Trial fit the transfer case. It should slip readily into place.

Bolt Up the 231 Transfer Case

As with the factory configuration, our adapter to transfer case interface features a dry cavity, and this should remain true so long as your oil seals in both the adapter and transfer case are doing their jobs. As such, match the aluminum face of the adapter to the transfer case front face. You may wish to lightly face any marks or debris from the 231 transfer case input face with a fine abrasive paper. The aluminum faces will conform to each other and provide a dustless cavity, though you are free to apply a thin bead of RTV to this face if you wish.

Install the transfer case with 3/8" bolts or studs (studs may be easier) and lockwashers. You may need to remove two of the odd-ball factory studs. Note that four-cylinder applications may have one of the six bolt holes plugged with a plastic stop that is easily removed. As with any other operation, do not use the transfer case bolts to press the adapter and transfer case together. If they bind, check for alignment or obstructions.

Mounting the Drivetrain Assembly

Based on our discussions with our callers, this is one topic that receives an inordinate amount of worry. Reinventing the wheel here is usually completely unnecessary. Most installations very successfully use the factory crossmember / skidpan for mounting the gearboxes. Every installation, without exception, must use a flexible, compressible transmission mount, also referred to as a rear motor mount. This mount will sit directly under the adapter, for which a cast-in pad and drilled holes are available. There are only rare instances where the base of your adapter need be modified.

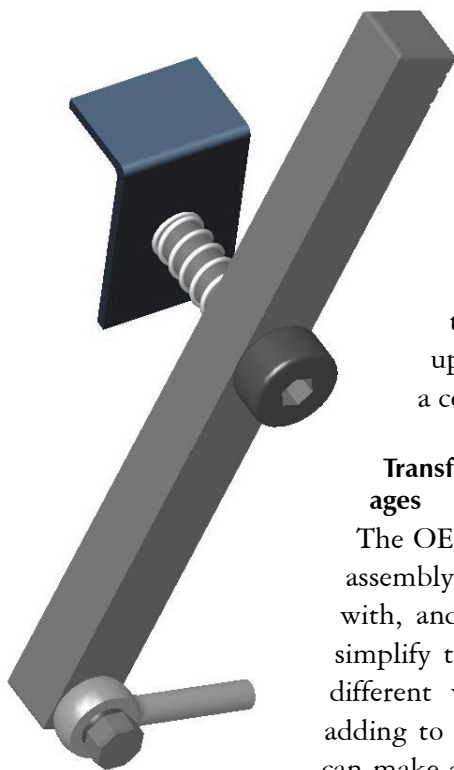
You will need to drill two holes in the factory crossmember for the lower (narrower) portion of the mount base. A block or box spacer under this mount is sometimes required to achieve the right tilt and tunnel clearance to the powertrain. In some cases, you may wish to relocate the crossmember forward on the frame, especially if you are working with a conversion engine that sits further forward than the factory Jeep options.



This popular rear mount is what we design our adapters to. It is a common Jeep/Chevy application and well supported by the aftermarket. This one pictured is our favorite, under the Novak #RMU designation.

We have seen certain instances of customers or their fabrication shops making custom, bar style crossmembers whose outer portions are anchored by step bushings and bolts on the frame. These bars are then bolted directly to the adapter base. This is usually done for the sake of ground clearance. This is a bad idea. While these side bushings may offer some lateral absorption, they offer virtually no longitudinal give. This risks breaking your transfer case, your adapter or your transmission. Stick with a mount as illustrated. If you must use a highly custom solution, make sure it is thoughtfully engineered to generously absorb shock and twist along every axis, including recoil.

Transmission Shifter



Because of varying engine positions and different shifter stick configurations, you will likely need to bend your SM420 shifter to match your Jeep's tunnel and your own ergonomics. Removal of the stick is easily done by pressing down and rotating the sprung hold down bezel surrounding the base of the shifter. You can then remove the shifter from the housing and heat it to achieve the proper bends. Follow up with a light sanding and a coat of enamel.

Transfer Case Shifter and Linkages

The OEM 231 transfer case shifter assembly can be difficult to work with, and we recommend that you simplify this. There are four known different versions of these shifters, adding to the variation. The installer can make a very useful shifter assembly with the use of standard, on-the-

shelf materials and components. Getting rid of the dummy-proof gated shifter plate is appropriate for an individual clever enough to do a transmission swap. We have found that the TJ versions of these shifters is a little easier to retain than their YJ predecessors, as they mount to the body and have a simple rod actuation system.

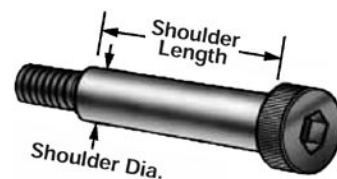
One suggestion is to drop an angle bracket off the side of the transmission as an anchor point. Use of two of the top cover bolts is excellent for this. You may also use two of the adapter bolts in some situations. The bracket should be rigid enough to handle the leverage the shifter generates. Use of a steel or aluminum rod (square or rectangular) for a new shifter lever is recommended.

Drill a hole through the rod that will be used as a pivot. Use a shoulder bolt as a pivot point. Typically, you will use a shoulder bolt with a 1/2" diameter shoulder. Your drill hole through the rod will be just larger than this for easy insertion, but not too loose. Run the shoulder bolt through the hole in the rod and secure it with a nut and lock washer on the inner side of the bracket you've made. A spring on the side will set your side-to-side distance and offer rigidity to the lever.

Driveshafts

Most factory transmission and adapter combinations to the Jeep transfer case vary. As such, it is often that driveshaft lengths will need to be changed to accommodate the swap. Also, consider that there multiple ways to install a conversion engine (often used with this transmission) and the following will be of note:

It is seldom a good idea to allow the driveshafts to make the decisions as to where the



A shoulder bolt makes for a perfect pivot. They are commonly available through industrial and fastener suppliers.



A top and side views of a shifter bracket on an SM420.



Shackle Reversal Caveats

If a shackle reversal has been or will be performed on the Jeep, it is crucial that you calculate the suspension geometry's effects on the front driveshaft. Shafts that are too long or do not have enough compression slip will cause the driveshaft to ram your transfer case, causing damage to your axle, driveshaft, transfer case, adapter or transmission.

powertrain will be placed. Some of our customers, fearful at the perceived expense of new or modified driveshafts, attempt to let the existing driveshafts dictate engine, transmission and transfer case location, sometimes to the detriment of the project. Driveshaft modifications are usually inexpensive when performed by driveline, RV or tractor implement specialists. New driveshafts are an option but seldom a requirement in regards to the actual successful conversion. Jeeps that require extensive travel or specialty-built driveshafts have this option available through several fabricators across the nation.

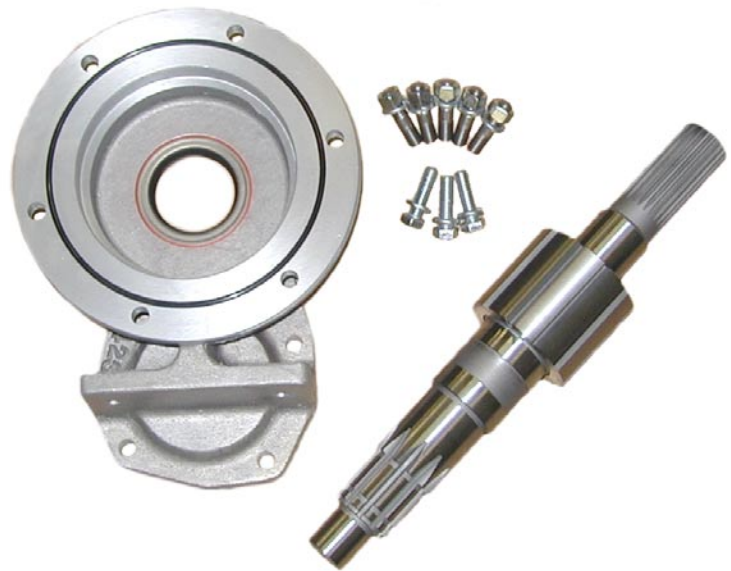
Finish mounting the transmission and engine and have the weight of the Jeep on the wheels when measuring the length to modify the driveshafts. Any changes in driveshaft length must be determined after the engine and transmission have been mounted. The Jeep must be sitting on the ground with its full weight on the wheels to make the best determination. Our experience has shown that some stock Jeep drive shafts are not quite the correct length from the factory to begin with. This can be corrected if the driveshafts are modified.

Conclusion

While reading through these instructions, and especially while performing the transmission swap, it is often recognized that it is not the swap itself that provides the greatest difficulty, but in the ancillary things like linkages, mounts, clearances, and the like. Any good installation should consider all the points in this article and also allow for time, energy and funds for the dozens of variations in drive train conversions that cannot be anticipated. When executed with care, this conversion can be a strong, enjoyable and reliable upgrade to your Jeep.

We strongly suggest that you keep these instructions for future reference. For questions concerning your conversion, contact the 4wd retailer or technician you bought the kit from. If you bought your conversion kit directly from us, contact us and we'll be pleased to answer your questions.

There is no final word to our instruction packages. We update them often and invite our customers to offer any suggestions, images or questions they may have that can make the process easier for any to follow. Note our contact information below.



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